Model for Managing Knowledge Workers

4

Assessing the status of knowledge in a company has to include methods of IC evaluation based on investment in the staff's knowledge development. However, there are no methods for assessing the efficiency of decisions with respect to acquiring knowledge. The literature distinguishes qualitative measures (e.g., the Danish Project of IC measurement; the Scandia Navigator; IAM; the IC-Rating model^{TM}; VCSTM; the Balanced Scorecard; Saratoga Institute Report) and methods of valuating IC (e.g., MV/MB indicator, Q-Tobin indicator, CIV indicator, KCE indicator, VAIC^{TM}, Economic Added Value, IAV model, Strassmann's method, IAMV^{TM}, Broker's Technology), as indicated in Chap. 2.

Ongoing attempts are being made to find methods for measuring IC, but there is still no widely accepted method for establishing an IC-assessment system. The difficulty is that the majority of the concepts have been formulated with respect to specific companies; the measuring methods have thus been tailor-made and do not permit general application. Because of the lack of concepts with respect to the assessment and forecasting value of knowledge workers in a company, the present study focuses on creating a method for assessing and predicting the value of knowledge workers in a company.

Many studies have focused on knowledge-management strategies from an organizational perspective (Barthelme et al. 1998; Basu 1998; Carayannis 1998; Drew 1999; Purser and Pasmore 1992; Studer et al. 1998). Sirmon and Hitt (2003) describe the primary processes for the effective management of resources in an organization. The first process is structuring the resource portfolio. This requires firms to engage in the acquisition and development of resources and, where necessary, removing less valuable resources. The second process entails bundling resources together to build unique, valuable capabilities.

Thus, describing knowledge workers as strategic-knowledge resources is motivated by the following:

- The concept of effective management of resources in an organization
- An enterprise's unique potential in the form of knowledge and experience (Barney 1995)
- The concept of competence management (Hamel and Prahalad 1994).

J. Patalas-Maliszewska, *Managing Knowledge Workers*, Management for Professionals,
DOI 10.1007/978-3-642-36600-0_4,

A strategic-knowledge resource in a company signifies the knowledge, skills, and capabilities of the individuals who make up the company's workforce. Such resources are usually reflected in a worker's education, experience, and specific identifiable skills (Hitt et al. 2001). Yet, how can resources be managed to create added value for an enterprise?

Makadok (2001) presented several stages in the management of a firm's resources. Sirmon and Hitt (2003) expanded Makadok's work to develop a model of how resources could be managed to create value. I will use the model of Sirmon and Hitt to examine five stages in the management of a firm's strategic-knowledge resources. These stages are identification, analysis, evaluation, configuring, and forecasting.

In this part of the monograph, I will present my method for assessing and forecasting the value of knowledge workers. Through a case study (assessing the value of the personnel usefulness function and the characteristics of innovation in ten companies), I will show how a matrix can be used to assess investment in knowledge. Subsequently, the concept of building a model supporting decision making will be presented; that model will allow the assessment and forecasting of knowledge workers in a company.

My research questions were as follows. Is it possible to describe the value of the knowledge of a given employee in an enterprise? Is there a method for assessing and predicting a knowledge worker's value in an enterprise?

4.1 Knowledge Workers as Strategic Knowledge Resources

4.1.1 Resource-Based Approach

As stated in the previous section, strategic-knowledge management is essential to achieving a competitive advantage (Hays and Kearney 2001). Purely operational measures—that is reactive rather than proactive, personal, and economic—are therefore inadequate as a means of differentiating one company from its competitors (Huselid et al. 1997). The theory of the resource-based view (RBV) appears to be appropriate as an economic theory for equally examining personnel policies and the impact of demographic changes (Boxall and Purcell 2000; Helfat and Peteraf 2003; Makadok 2001). The basic assumption of the RBV is that the individual organization's success is the result of the competition among heterogeneous resource endowments. In this respect, the focus is on those resources that have been developed within an organization. Only those resources can be a source of competitive advantage since they are tied to company-specific on a long-term basis (Argote and Ingram 2000; Barney and Zając 1994; Lado and Wilson 1994). RBV researchers have already applied their methods to different business areas (Acedo et al. 2006).

The RBV is the result of the work of Penrose (1959); Wernerfelt (1984) presented his RBV of the firm, but the first comprehensive description of the RBV approach was published by Wright et al. (2001). Among others, Barney

(1991) focused on internal company resources (Prezewowsky 2007), and Barney established groundbreaking specifications that detailed how a competitive advantage could lead to resource properties (Wright et al. 2001). In the literature, there are very different definitions of the term "resource" for the purposes of the RBV. The various interpretations cover not only clarification of the terminology but also the categorization of resources and the attribution of resource properties and their contribution to competitive positions. Lado and Wilson summarized the findings in the literature: they stated that a company is a network of resources and skills and that potential sources of sustainable competitive advantage exist if the economic benefits provided by the company's services are not fully replicated by competitors' activities (Lado and Wilson 1994).

The term "resource-based" refers to the total competitive success of a company's underlying resources and combinations of its resources. These resources must however meet certain characteristics—in recent years in the literature as follows:

- Nolte and Bergmann (1998): durability, usability, relative rarity, rarity, transferability, substitutability, inimitability, ambiguity, specificity, complexity, tacitness, historicity
- Barney (2001): value, rareness, imperfect imitability, substitutability
- Grant (1997): durability, transparency, transferability, replicability
- Eriksen and Mikkelsen (1996): value, heterogeneity, imitability, substitutability
- Smart and Wolfe, (2000): value, strategic relevance, sustainability, mobility, inimitability, substitutability, strategic flexibility

The differences among the authors may be the result of different levels of detail in their definition.

The RBV assumes that this heterogeneity and the result of entrepreneurial activity are due to the uneven distribution of resources. At the same time, this resource heterogeneity does not take into account microeconomic considerations owing to the fact that these company-specific resources rely on imbalances in the market and involve high transaction costs (Barney 1991). The competitive advantages relate more to a company's use of equipment and resources than to its product-market position (Lado and Wilson 1994).

The positive results of the RBV have been emphasized in relevant studies (Colbert 2004; Wright et al. 2001; Freiling 2001; Führing 2006).

These positive features include wide, rapid dissemination in the scientific literature and in management practices; they also include the heterogeneous character of the RBV, such that different theories and perspectives can be integrated within it, which adds to its status as primarily a strategic management approach (Acedo et al. 2006). The great advantage of the RBV over the prevailing market-based view is that it assesses competitive success primarily in terms of specific market situations and the corporate potential for creating mutually dependent relationships (Prezewowsky 2007). With the increasing complexity and dynamic character of the business environment, the possibilities of developmental analysis, and lack of predictability with regard to influencing environmental factors, it is important to examine strategically relevant internal factors in a business that would allow a prediction of success. However, discussions about the methodical status of the RBV

are incomplete. The criticism has been leveled that too few efforts have been made for a theoretical structure for the RBV to be developed (Priem and Butler 2001). In particular, the long-existing confusion about dealing with resources and understanding the terminology assumptions have led to further censure of the RBV. Many studies have been based on the RBV; however, the use of the frequency range has been presented as an argument for its empirical validity (Barney 2001).

The lack of analytical and empirical foundations for classifying and defining human resources as strategic assets in recent years was discussed by Prezewowsky (2007). Uncertainty has led to difficulties in the practical use of resources. However, it has been noted that the very lack of appropriate tools "to implement a resource-oriented management" is a cause for concern (Boos and Jarmai 1994).

Criticism about the static nature of conventional RBV has been reflected in the fact that through constant changes in the environment, companies are forced to adjust their resource endowments, reconfigure, and stabilize (Becker 2004; Pfeffer and Salancik 1978; Priem and Butler 2001). This resulted in the dynamic capabilities approach. "Dynamic" here relates to the ability to adapt to a changing business environment; "capabilities" emphasizes the key role of strategic management and the internal and external perception of organizational skills (Teece et al. 1997). In turn is carried out by individuals primarily through organizational learning processes.

It is often stated in the literature that there is a need for an efficient, robust tool that is capable of measuring the value of employees. A proper solution to this urgent question is long overdue.

Resources are important to a firm's performance; however, according to the RBV, whether an organization gains a competitive advantage and any associated returns depends on the strategic planning used to leverage those resources (Chrisman et al. 2003; McGrath and MacMillan 2000).

The need to describe knowledge workers as a strategic-knowledge resource is motivated by the concept of resource management and competence management (Fig. 4.1) (Patalas-Maliszewska and Hochmeister 2011).

Here, I will briefly describe competence management in a company. The significance of competence management in knowledge-intensive businesses is well established. As a subdivision of knowledge management, competence management deals with the knowledge of individuals, i.e., their competences. The capabilities of individuals in accomplishing a task are often referred to using such terms as qualifications, skills, and competences. However, an explicit difference is made in the literature between these concepts. The concept of competence is represented by a combination of knowledge, behavior, and skills that give an individual the potential to perform a task effectively (Draganidis and Mentzas 2006; Penner-Hahn and Shaver 2005).

The aim of competence management is to plan, implement, and evaluate initiatives that ensure that the proper competences are available to a company, thereby allowing it to achieve its business objectives (Nordhaug 1993). To support this task, Berio and Harzallah (2005) define four processes for competence management:

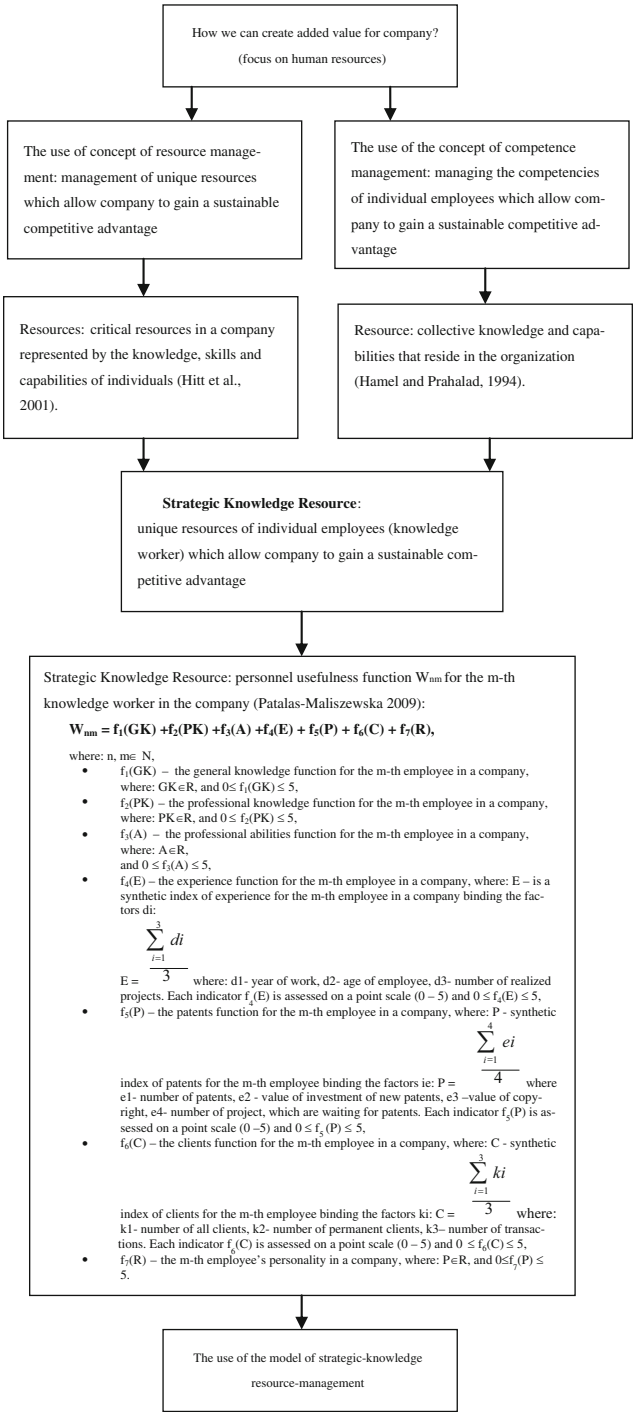

Fig. 4.1 Definition of strategic-knowledge resources in a company (Source: Patalas-Maliszewska and Hochmeister 2011)

- Competence identification—defining the required competence
- Competence assessment—determining whether a competence has been acquired
- Competence acquisition—planning how required competences can be acquired
- Competence usage—systematically utilizing knowledge about competences for the benefit of an organization

For a company to preserve its competitive edge, it is necessary to develop a competence-management system. In general terms, competence management operates on two levels—the macro and the micro. The former is concerned with core competences and is controlled by business management. Thus, a core competence is understood as signifying the total collective knowledge and capabilities that reside in an organization (Hamel and Prahalad 1994). On the micro level, led by human-resource management, the focus lies on the competences of individual employees. The competences a company requires to meet its strategic goals are transformed from the macro to the micro level. Conversely, existing competences on the micro level are exchanged via business management to support strategy design.

I distinguish the value of knowledge workers—specialists in selling—as follows: m1, sales director; m2, sales specialist; m3, marketing specialist; m4, regional assistant; and m5, product manager—the list has been already presented in Sect. 3.2.2. I do this using the personnel usefulness function (Patalas-Maliszewska 2011).

4.1.2 Personnel Usefulness Function for a Knowledge Worker

I define here the personnel usefulness function, W_{nm}, for the m-th knowledge worker in the n-th functional area in a company:

$$W_{nm} = f(GK,\ PK,\ A,\ E,\ P,\ C,\ R),$$

where n, m∈N and:

- GK—general knowledge of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated in the range of 1–5, where 1 is a poor and 5 a very good level of general knowledge.
- PK—professional knowledge of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated in the range of 1–5, where 1 is a poor and 5 a very good level of professional knowledge.
- A—professional abilities of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated in the range of 1–5, where 1 is a poor and 5 a very good level of professional abilities.
- E—experience of the m-th employee. The value of this parameter is obtained through tests for employees; it is evaluated within the range of 1–5, where 1 is a poor and 5 a very good level of experience.

- P—patents of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated within the range of 1–5, where 1 is a poor and 5 a very good level of patents.
- C—clients of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated within the range of 1–5, where 1 is a poor and 5 a very good level of clients.
- R—personality of the m-th employee. The value of this parameter is obtained through the results of tests for employees; it is evaluated within the range of 1–5, where 1 is a poor and 5 a very good level of personality.

Effectiveness is measured in terms of degree. It is achieved in systems in which planning and efficiency are also defined by degree (Kosieradzka and Lis 2000). Thus, parameters E, P, and C are related to effectiveness; parameters GK, PK, A, and R are related to efficiency.

The following personnel usefulness function, W_{nm}, for the m-th knowledge worker in the company is proposed:

$$\mathbf{W_{nm}} = \mathbf{f_1(GK)} + \mathbf{f_2(PK)} + \mathbf{f_3(A)} + \mathbf{f_4(E)} + \mathbf{f_5(P)} + \mathbf{f_6(C)} + \mathbf{f_7(R)},$$

where n, m$\in$ N.

The linear form of this function, W_{nm}, is chosen because all elements are independent and equally important in assessing the effectiveness and efficiency of investment in knowledge:

- f_1(GK)—the general knowledge function for the m-th employee in a company, where GK$\in$R, and $1 \leq f_1(GK) \leq 5$.
- f_2(PK)—the professional knowledge function for the m-th employee in a company, where PK$\in$R, and $1 \leq f_2(PK) \leq 5$.
- f_3(A)—the professional abilities function for the m-th employee in a company, where A$\in$R, and $1 \leq f_3(A) \leq 5$.
- f_4(E)—the experience function for the m-th employee in a company, where E is a synthetic index of experience for the m-th employee in a company binding the factors ei: $E = \frac{\sum_{i=1}^{3} di}{3}$, where e1—year of work; e2—age of employee; e3—number of realized projects. Each indicator f_4(E) is assessed on a points scale (1–5) and $1 \leq f_4(E) \leq 5$.
- f_5(P)—the patents function for the m-th employee in a company, where P—synthetic index of patents for the m-th employee binding the factors pi: $P = \frac{\sum_{i=1}^{4} ei}{4}$ where p1—number of patents; p2—value of investment of new patents; p3—value of copyrights; p4—number of projects that are awaiting patents. Each indicator f_5(P) is assessed on a points scale (1–5) and $1 \leq f_5(P) \leq 5$.
- f_6(C)—the clients function for the m-th employee in a company, where C—synthetic index of clients for the m-th employee binding the factors ci: $C = \frac{\sum_{i=1}^{3} ki}{3}$

where c1—number of all clients; c2—number of permanent clients; c3—number of transactions. Each indicator $f_6(C)$ is assessed on a points scale (1–5) and $1 \leq f_6(C) \leq 5$.

- $f_7(R)$—the m-th employee's personality in a company, where $P \in R$ and $1 \leq f_7(P) \leq 5$.

It is possible to obtain the necessary data for evaluating the personnel usefulness function from knowledge worker-oriented companies through interviews conducted at each enterprise. Each knowledge worker completes the questionnaire. Using an algorithm to test solutions for each employee, it is possible to determine a specific value for the personnel usefulness function and each of the parameters pertaining to this function. I present here an algorithm for obtaining the value function.

I would like to note that the substantive content of the following tests can be modified to meet the requirements of a given workplace in a management company. The following example shows only one set of possible questions to demonstrate the applicability of this function, W_{nm}.

4.1.2.1 f_1(GK): General Knowledge Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_1(GK)}$, the m-th employee completes the following test. This is an example of my verification test for general knowledge of the m-th employee in the sales area.

Test (GK):

1. For marketing resources should not be:
   - Price
   - Demand
   - Product
   - Promotion
2. The life cycle of a product/service is:
   - The appearance of the product
   - Product quality
   - The length of the product life
   - Change in product prices
3. Product mix:
   - The set of all product lines
   - A collection of only one type of product
   - A collection of products aimed at a market
   - A collection of products with the same price
4. Distribution channels are different:
   - Market channels
   - Strategic channels
   - Economic channels
   - Production channels

5. Advertising is:
   – Any form of nonpersonal presentation and promotion of the product (service)
   – Paying for an impersonal form of presentation and promotion of the product (service)
   – Short-term action to boost sales of the product (service)
   – Any action aimed at promoting the product (service)
6. Direct marketing is:
   – Personal and direct presentation of the product (service)
   – Any form of nonpersonal presentation and promotion of the product (service)
   – Customer relationship management
   – The use of nonpersonal contact tools to communicate with the client
7. Sales promotion is:
   – Short-term action to boost sales of the product (service)
   – The planned long-term promotion of a product (service)
   – Measures to promote the product (service) conducted via the Internet
   – Measures to promote the product (service) conducted by telephone
8. Public relations is:
   – Promotion of products (services) in the media without permission
   – Planned promotion campaign in the media
   – The long-term promotion of products (services) in the media
   – Any action aimed at promoting the product (service)
9. Carrying out activities aimed at building a strategy for the company is important because:
   – Does not allow long-term development of the company in an industry
   – Anticipated change in the business environment
   – Does not allow development in conditions of increasing competition
   – Allows the elimination of the risk of misdiagnosis of business development
10. Asset-enterprise strength is not:
   – The possibility of extending the range
   – Good reputation with customers
   – Being recognized as a market leader
   – Experienced management team

To obtain the value of $\mathbf{f_1(GK)}$ we employ an algorithm:

- If a user has 5 or fewer correct answers: 1 point
- If a user has 6 correct answers: 2 points
- If a user has 7 correct answers: 3 points
- If a user has 8 correct answers: 4 points
- If a user has 9–10 correct answers: 5 points

4.1.2.2 f_2(PK): The Professional Knowledge Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_2(PK)}$, the m-th employee completes the following test (an example of the author's verification test of professional knowledge for the m-th employee in the sales area):

Test (PK):

1. Does the company intend to launch a new product on the market?
   - Yes
   - No
   - I do not know
2. Does the company intend to change the user market?
   - Yes
   - No
   - I do not know
3. Does the company want to introduce new sales channels?
   - Yes
   - No
   - I do not know
4. Does the company want to enter new markets?
   - Yes
   - No
   - I do not know
5. Does the customer have an exclusive supply provider?
   - Yes
   - No
   - I do not know
6. Is the client sensitive to price changes?
   - Yes
   - No
   - I do not know
7. Does the client use the supplier's Web site?
   - Yes
   - No
   - I do not know
8. Is the customer satisfied with the work of the supplier's sales offices?
   - Yes
   - No
   - I do not know
9. Is the customer satisfied with the terms of vendor contracts?
   - Yes
   - No
   - I do not know
10. Is the customer kept informed about changes in the company?
    - Yes
    - No
    - I do not know

The value of $\mathbf{f_2(PK)}$ is obtained from an algorithm:

- If there are 7–10 "I do not know" answers: 1 point
- If there are 5–6 "I do not know" answers: 2 points
- If there are 4 "I do not know" answers: 3 points

- If there are 2–3 "I do not know" answers: 4 points
- If there are 0–1 "I do not know" answers: 5 points

4.1.2.3 $f_3(A)$: Professional Abilities Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_3(A)}$, the m-th employee completes the following table (an example of the author's verification test of abilities for employee in the sales area):

Table (A)

	Occasionally	Sometimes	Often	Very often	Always
I represent the interests of the client's in my own company					
I maintain contacts with customers after the sale					
I supplement knowledge about changes of product range in my company's					
I inform customers about changes in the market					
I supplement knowledge about changes in product mix at the customer					
I prepare to talk to my customers					
I lead discussions with clients					

The value of $\mathbf{f_3(A)}$ is obtained from an algorithm:

- If there are 5–7 "occasionally" answers: 1 point
- If there are 4 "occasionally" answers: 2 points
- If there are 3 "occasionally" answers: 3 points
- If there are 2 "occasionally" answers: 4 points
- If there is 1 "occasionally" answer: 5 points

4.1.2.4 $f_4(E)$: Experience Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_4(E)}$, the m-th employee completes the following table (an example of the author's verification test of experience of the m-th employee in the sales area):

Table $\mathbf{f_4(E)}$:

e_1—number of years in a company
e_2—an age
e_3—the number of my ideas realized

The value of $\mathbf{f_4(E)}$ is obtained from an algorithm E:

$$\frac{\sum_{i=1}^{3} ei}{3}$$

where e_1—number of years in business, e_2—age, e_3—the number of my ideas realized.

- If there are 25 or fewer points: 1 point
- If there are 26–40 points: 2 points
- If there are 41–50 points: 3 points
- If there are 51–60 points 4 point
- If there are over 60 points: 5 points

4.1.2.5 $f_5(P)$: Patents Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_5(P)}$, the m-th employee completes the following table (an example of the author's verification test of patents experience for the m-th employee in the sales area):

Table $\mathbf{f_5(P)}$:

p_1—the value of my patents
p_2—the number of my patents
p_3—the value of my copyright
p_4—the number of my projects pending patent

The value of $\mathbf{f_5(P)}$ is obtained from an algorithm P:

$$\frac{\sum_{i=1}^{4} ei}{4}$$

where p_1—the value of my patents, p_2—the number of my patents, p_3—the value of my copyright, p_4—the number of my projects pending patent.

- If there are 0 points: 1 point
- If there are over 0 points: 5 points

4.1.2.6 $f_6(C)$: Clients Function for the m-th Knowledge Worker in a Company

To obtain the value for $\mathbf{f_6(C)}$, the m-th employee completes the following table (an example of the author's verification test of the m-th employee's relationship with clients in the sales area):

Table $\mathbf{f_6(C)}$:

c_1—the number of my customers
c_2—the number of my regular customers
c_3—the number of my transactions (such as auction business documents, contracts, acquired clients)/month

The value of $\mathbf{f_6(C)}$ is obtained from an algorithm:

- If any answer is given: 1 point
- If only the answer "the number of my customers" is given: 2 points

- If only the answer "the number of my regular customers" is given: 3 points
- If 2 answers are given: 4 points
- If 3 answers are given: 5 points

4.1.2.7 f_7(R) m-th Knowledge Worker's Personality in a Company

To obtain the value for $\mathbf{f_7(R)}$, the m-th employee completes the following table (an example of the test of the m-th employee's personality in the sales area):

Table (R) based on the Nosal 2002:

I care more about	The feelings of people	Their rights
I am usually more comfortable with people	Who are gifted with imagination	Who are realists
A bigger compliment is to define someone as	Influencing other people	A rationally thinking person
If I do something together with many people, it is more important for me	To act in an acceptable manner	To find my own course of action
I am more irritated by	Theorists	Extreme practitioners
Higher praise should be given to someone	With vision	With common sense
With me, it is more for	My heart to rule my head	My head to rule my heart
I think a bigger mistake is	An excessive display of warm feelings	Not being simpatico
If I were a teacher, I would prefer to teach:	Theoretical subjects	Subjects based on important facts
Which word appeals to you more?	Compassion	Predictability
Which word appeals to you more?	Justice	Pity
Which word appeals to you more?	Production	Project
Which word appeals to you more?	Mild	Firm
Which word appeals to you more?	Indiscriminate	Critical
Which word appeals to you more?	Literal	Figurative
Which word appeals to you more?	Ingenious	Practical

The value of $\mathbf{f_7(R)}$ is obtained from an algorithm:

- Sensitive: 2b, 4a, 5a, 6b, 9b, 12a, 15a, 16b
- Intuition: 2a, 4b, 5b, 6a, 9a, 12b, 15b, 16a
- Thinking: 1b, 3b, 7b, 8a, 10b, 11a, 13b, 14b
- Feelings: 1a, 3a, 7a, 8b, 10a, 11b, 13a, 14a

Interpretation of results:

- Indication of intuition: if the intuition total is equal to or more than the senses total
- Indication of senses: if senses total is greater than the intuition total
- Indication of feelings: if the feelings total is equal to or greater than the thinking total
- Indication of thinking: if the thinking total is greater than the feelings total

(The two highest of the above scores are chosen and in accordance with the model of a knowledge worker-oriented company):

- If you are a sales director/product manager and senses are indicated: 5 points.
- If you are a sales director/product manager and intuition is indicated: 1 point.
- If you are a sales director/product manager and thinking is indicated: 3 points.
- If you are a sales director/product manager and feelings are indicated: 2 points.
- If you are a sales specialist/regional assistant and senses are indicated: 3 points.
- If you are a sales specialist/regional assistant and intuition is indicated: 5 points.
- If you are a sales specialist/regional assistant and thinking is indicated: 1 point.
- If you are a sales specialist/regional assistant and feelings are indicated: 2 points.
- If you are a marketing specialist and the senses are indicated: 1 point.
- If you are a marketing specialist and intuition is indicated: 1 point.
- If you are marketing specialist and thinking is indicated: 2 points.
- If you are a marketing specialist and feelings are indicated: 5 points.
- If you are a regional assistant and the senses are indicated: 4 points.
- If you are a regional assistant and intuition is indicated: 1 point.
- If you are a regional assistant and thinking is indicated: 3 points.
- If you are a regional assistant and feelings are indicated: 1 point.
- If you are a product manager and the senses are indicated: 4 points.
- If you are a product manager and intuition are indicated: 1 point.
- If you are a product manager and thinking is indicated: 2 points.
- If you are a product manager and feelings are indicated: 5 points.

After the various parameters are obtained for the knowledge worker, the value of the personnel usefulness function is obtained as follows:

$$W_{nm} = f_1(GK) + f_2(PK) + f_3(A) + f_4(E) + f_5(P) + f_6(C) + f_7(R)$$

where n, m$\in$ N.

It should be noted that the proposed approach for measuring the personnel usefulness function offers an estimated value of the knowledge workers in a company. The personnel usefulness function may be used as complement to traditional means of valuation in a company, which are usually based on the value of tangible assets. Still, the problem remains unsolved: it is not possible to assign individual workers to future revenue streams in an organization because such streams arise as a result of human interaction with the work.

One of the instruments used in knowledge management is knowledge of an individual. The proposed personnel usefulness function may be treated as an extension of knowledge management in an organization (according to the concept of Maier 2002). It is necessary to map the sources of knowledge, management expertise, and experience of the individual.

The value function may be useful to determine the amount of IC in organizations based on the personal usefulness function and the individual value of each knowledge worker. The proposed approach with the personal usefulness function amounts to adjusting the measurements to a specific job and company characteristics.

The personnel usefulness function introduced in this section offers more possibilities in the area of knowledge profitability. Beyond being a basic calculation of investment profitability, this approach appears to be an excellent tool for

analyzing a knowledge worker's value. I will now describe conventional methods of employment planning and selection to demonstrate that there is a gap in the methods of planning and evaluation of knowledge workers in terms of their innovation level in a company.

4.2 Methods of Employment Planning and Selection

Management of potential social organizations requires definitions of the elements and tools for implementing personnel function. Personnel function in a company covers all matters relating to the people in the organization, including their acquisition, management, and professional development. It has been proposed that regulatory activities under this function (planning, organizing, motivating, and controlling) be referred to as personnel management (Lichtarski 2000; Studer et al. 1998; Perry et al. 1996; Krämer et al. 2005).

The role of the personnel function has evolved from an operational to a strategic one. This role has been as follows: (1) operational—administration of payroll in the company (1900–1945); (2) managerial (tactical)—bearing responsibility for administration and recruitment, maintenance of relationships with the labor market (1945–1980); (3) strategy-including the formulation of human resources strategy (since 1980) (Król and Ludwiczyński 2007). The personnel function is undergoing continual development for the following reasons: increased international competition; the size and complexity of modern enterprises; higher level of workforce education; changing workforce demographics (greater participation of women and ethnic minorities in the workforce).

Employment plans in enterprises should reflect the demand for labor in terms of qualitative and quantitative criteria for evaluating employees and the manner and form of motivating those employees. The selection of appropriate employment planning methods depends on several key factors: the planning horizon, sources of information used in the planning process, the cost of applying the method.

In the literature, different methods of planning divisions of employment are given: (1) analytical and descriptive methods, and (2) statistical methods. The first group includes the following:

- Managerial assessment—a method of forecasting the demand for human resources (Armstrong 2001). It is assumed that managers understand personnel needs best. Data collected from managers are subject to gradual aggregation. This method can be carried using a top-down approach: employment forecasts are prepared by top management and then agreed upon and presented to lower-level managers. It can also be carried using a bottom-up approach: the lowest-level managers prepare information on staff demand in their area, and this is forwarded to top management.
- Delphi method—this involves setting up a group of experts, who draw up views on the supply and demand of human resources (King 2007).

- Benchmarking method—this determines the demand for workers on the basis of information about employment in the best companies of a similar profile (Ramos-Rodriguez and Ruiz-Navarro 2004).
- Forecasting the zero-based –this takes as a starting point the current state of employment, but every year the base is adjusted and updated. If there is a need for hiring an employee, checks are made against this base as to whether the move is justified (Kostera 2000).
- Indicator method—there are set percentages (numbers) for individual professional groups within the company as a part of total employment (McKenna and Beech 1997).
- Method proposed by labor standards—time, performance, handling, and stocking. Depending on the solutions contained in the system and the standardization of work, the necessary employment in the company can be calculated (Pawlak 2003).

The second group includes the following:

- Statistical analysis—using past data and inputting them into the forecast. Prognostic variables are those factors that have had an impact on employment in the past, such as sales volume and productivity (Gajek and Kałuszka 2000)
- Markov analysis—historical trends are treated as the base from which to formulate future proposals (Szałkowski 2002)
- Scenario forecasting—creative planning that involves preparing several scenarios of events (Sekuła 2001)
- Computer simulation—experimenting with possible and probable situations (Szałkowski 2002)

The skilful use of different instruments in shaping employment in an organization requires management and the human resource professionals to operate in their respective spheres of competence. The employee-selection process comprises all activities that are aimed at hiring competent employees, whose work should contribute to the mission and goals of the organization (Pawlak 2003). The following methods are notable in the employee-selection process: (1) internal recruitment—advertisements in the intranet, reserve personnel, list of success stories, contests; (2) external recruitment—advertisements in the press, Internet, radio, television, employee recommendations, employment agencies, universities; (3) selection—analysis of documents, interviews, tests, assessment center, unconventional methods, such as astrology; (4) adaptation—preliminary evaluation of the employee.

I have attempted to develop a method for forecasting and selecting knowledge workers in a company: the Sknowinnov method. This method contains elements of benchmarking methods, statistical analysis, and Markov analysis and the tests used in employee-selection methods. The Sknowinnov method allows the evaluation of candidates according to accepted examination criteria and is in line with the strategic objectives of a company in terms of innovation.

4.3 New Concept for Planning and Assessing Knowledge Workers

4.3.1 Sknowinnov Method for Assessing the Value of Knowledge Workers

The decision about selecting appropriate knowledge workers requires that the company management assess the efficiency of the investment. The application of the Sknowinnov method makes it possible to obtain a forecast of the value of a knowledge worker.

This research was motivated by the actual need of manager, who had a strong desire to improve his own company's innovation level through selecting knowledge workers. This research thus began with a literature review of employee-selection methods and definitions of knowledge workers. Next, based upon empirical research in Polish companies, the Sknowinnov method and polynomial models of decision making ("the best polynomials") for individual knowledge workers (m1, m2, m3, m4, and m5) was created. The method allows a multi-criteria evaluation of the effectiveness of knowledge-worker selection in a company.

The Sknowinnov method consists of four elements (Patalas-Maliszewska 2009; Patalas-Maliszewska and Werthner 2010):

- Experience in companies regarding investment in knowledge: research results (sets of business processes are created for the m-th knowledge worker in the n-th functionality area, for example the sales area in a company; see Sect. 3.2.2)
- Indicator matrix to assess the effectiveness and efficiency of investment in knowledge workers: research results from ten companies (value of the personnel usefulness function).
- Innovation: values of the characteristics of innovation in a company—see Chap. 3: research results from ten companies
- The group data handling method (GMDH) algorithm (Farlow 1984)

Figure 4.2 presents an overview of the Sknowinnov method.

4.3.1.1 Indicator Matrix to Assess the Effectiveness and Efficiency of Investment in Knowledge Workers: Research Results from Ten Companies

The indicator matrix is proposed based on the literature and my own research. The matrix will help in assessing the effectiveness of knowledge worker selection in a company. The indicators (values of personnel usefulness function) include measures to show the value of knowledge workers in a company.

The next step involves a survey of selected companies (research focus group), which was done by conducting interviews in ten companies that conformed to the model of a knowledge worker-oriented company. Based on the results of research in the sales area in companies (the research group consisted of ten companies that conformed to the concrete model of an enterprise; see Sect. 3.2.2), the values of the

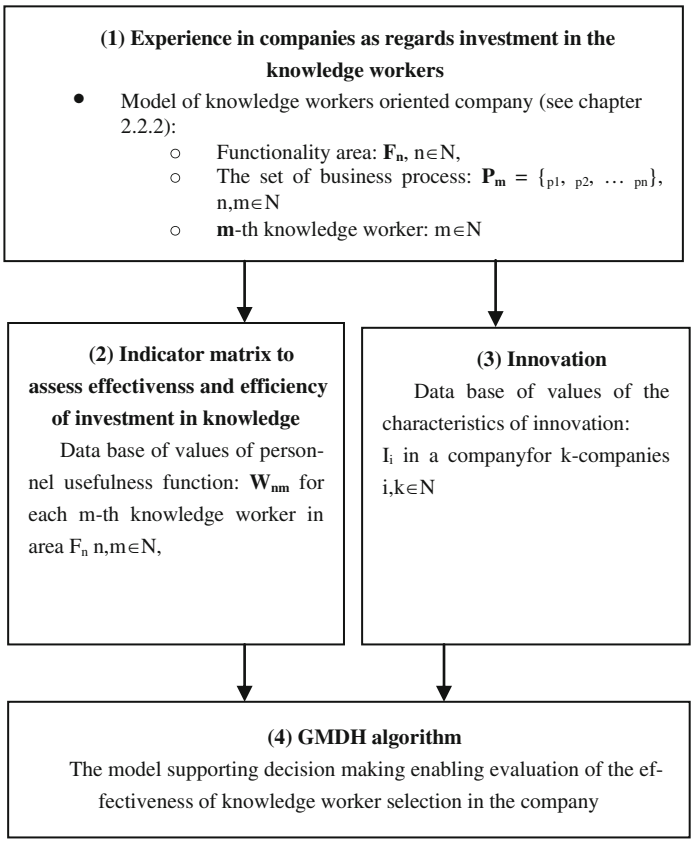

Fig. 4.2 Sknowinnov method

personnel usefulness function for five knowledge workers (m = 5) were assessed: m_1, sales director; m_2, sales specialist; m_3, marketing specialist; m_4, regional assistant; m_5, product manager. This was carried out in the sales area (n = 1) in each of the ten companies (matrix of the personnel usefulness function)—Tables 4.1 and 4.2.

To determine whether the result is good for a given enterprise, it is necessary to compare that result with the values for the sales department for each employee of another enterprise according to the reference model. Next, we can consider if the present condition of IC is satisfactory.

Figure 4.3 presents example of the values of the personnel usefulness function in the sales area in ten companies for a sales specialist based on the research results.

We can compare the value of the personnel usefulness function in the sales area for a sales specialist and the best result received for an employee in ten companies.

Table 4.1 Values of the personnel usefulness function in the sales area in ten companies: the matrix of the personnel usefulness function for five knowledge workers (m = 5) in the sales area (n = 1) in ten companies

	m_1	m_2	m_3	m_4	m_5
Company/sale area	Sales director	Sales specialist	Marketing specialist	Regional assistant	Product manager
C1/1	$W_{C1/11} = 25$	$W_{C1/12} = 4$	$W_{C1/13} = 12$	$W_{C1/14} = 13$	$W_{C1/15} = 16$
C2/1	$W_{C2/11} = 19$	$W_{C2/12} = 13$	$W_{C2/13} = 18$	$W_{C2/14} = 19$	$W_{C2/15} = 18$
C3/1	$W_{C3/11} = 21$	$W_{C3/12} = 15$	$W_{C3/13} = 12$	$W_{C3/14} = 12$	$W_{C3/15} = 20$
C4/1	$W_{C4/11} = 15$	$W_{C4/12} = 12$	$W_{C4/13} = 14$	$W_{C4/14} = 17$	$W_{C4/15} = 16$
C5/1	$W_{C5/11} = 12$	$W_{C5/12} = 17$	$W_{C5/13} = 13$	$W_{C5/14} = 15$	$W_{C5/15} = 17$
C6/1	$W_{C6/11} = 17$	$W_{C6/12} = 9$	$W_{C6/13} = 12$	$W_{C6/14} = 8$	$W_{C6/15} = 16$
C7/1	$W_{C7/11} = 21$	$W_{C7/12} = 13$	$W_{C7/13} = 19$	$W_{C7/14} = 19$	$W_{C7/15} = 18$
C8/1	$W_{C8/11} = 21$	$W_{C8/12} = 18$	$W_{C8/13} = 12$	$W_{C8/14} = 16$	$W_{C8/15} = 19$
C9/1	$W_{C9/11} = 15$	$W_{C9/12} = 12$	$W_{C9/13} = 14$	$W_{C9/14} = 17$	$W_{C9/15} = 16$
C10/1	$W_{C10/11} = 23$	$W_{C10/12} = 19$	$W_{C10/13} = 13$	$W_{C10/14} = 15$	$W_{C10/15} = 23$

Other companies can then decide whether the present condition of the knowledge worker as a sales specialist is satisfactory or not.

4.3.1.2 Innovation: Values of the Characteristics of Innovation in a Company: Research Results from Ten Companies

This step involved a survey among selected companies. This was carried out by interviews in the ten companies that conformed to the model of a knowledge worker-oriented company. Based on the research results in the sales area the characteristics of innovation (defined in Sect. 3.2.3) in the ten companies were determined.

where

- X_1—share of new products and technologies in the company's annual sales,
- X_2—number of new products implemented in a given year (for the last 5 years),
- X_3—number of new technologies implemented in a given year (for the last 5 years),
- X_4—number of completed research topics in a given year (for the last 5 years),
- X_5—number of patents in a given year (for the last 5 years),
- X_6—share of spending on research granted during the year to the value of sales,
- X_7—number of employees with science degrees,
- X_8—number of employees with higher education in relation to other staff,
- X_9—number of scientific publications,
- X_{10}—number of awards received in competitions,
- X_{11}—number of sold licenses developed in a given year (for the last 5 years),
- X_{12}—number of implementations of solutions developed in a given year (for the last 5 years), and
- X_{13}—number of purchased and used licenses

Table 4.2 Values of the personnel usefulness function in the sales area in ten companies: the matrix of the personnel usefulness function for five knowledge workers (m = 5) in the sales area (n = 1) in ten companies—workplaces

Company	Workplace in the sale area	W_{1m}	% of max $W_{1m} = 35$	f_1(GK)	f_2(PK)	f_3(A)	f_4(E)	f_5(P)	f_6(C)	f_7(R)
C1	Sales director	25	71	1	5	5	4	0	5	5
C1	Sales specialist	4	12	2	2	0	0	0	0	0
C1	Marketing specialist	12	34	2	4	0	0	0	0	6
C1	Regional assistant	13	37	3	3	2	0	0	1	4
C1	Product manager	16	46	0	3	4	2	0	3	4
C2	Sales director	19	54	2	4	2	2	0	4	5
C2	Sales specialist	13	37	1	4	2	2	0	4	0
C2	Marketing specialist	18	51	3	5	5	3	0	1	1
C2	Regional assistant	19	54	0	2	4	5	0	4	4
C2	Product manager	18	51	3	3	3	5	0	4	0
C3	Sales director	21	60	2	3	5	2	0	4	5
C3	Sales specialist	15	43	2	3	5	1	0	4	0
C3	Marketing specialist	12	34	1	1	5	1	0	4	0
C3	Regional assistant	12	34	1	2	2	0	0	3	4
C3	Product manager	20	57	3	2	5	1	0	4	5
C4	Sales director	15	43	0	4	5	1	0	4	1
C4	Sales specialist	12	34	0	2	5	1	0	4	0
C4	Marketing specialist	14	40	0	3	5	1	0	4	1
C4	Regional assistant	17	49	0	3	5	5	0	4	0
C4	Product manager	16	46	0	2	5	0	0	4	5
C5	Sales director	12	34	0	2	5	0	0	4	1
C5	Sales specialist	17	49	2	3	5	3	0	4	0
C5	Marketing specialist	13	37	2	3	2	1	0	4	1
C5	Regional assistant	15	43	2	4	5	0	0	4	0

(continued)

Table 4.2 (continued)

Company	Workplace in the sale area	W_{1m}	% of max $W_{1m} = 35$	f_1(GK)	f_2(PK)	f_3(A)	f_4(E)	f_5(P)	f_6(C)	f_7(R)
C5	Product manager	17	49	3	1	4	5	0	4	0
C6	Sales director	17	49	1	2	5	4	0	5	0
C6	Sales specialist	9	26	3	2	4	0	0	0	0
C6	Marketing specialist	12	34	2	4	0	0	0	0	6
C6	Regional assistant	8	23	2	3	2	0	0	1	0
C6	Product manager	16	46	0	3	4	2	0	3	4
C7	Sales director	21	60	3	4	2	2	0	4	6
C7	Sales specialist	13	37	1	4	2	2	0	4	0
C7	Marketing specialist	19	54	3	2	5	4	0	1	4
C8	Regional assistant	19	54	3	2	4	2	0	4	4
C8	Product manager	18	51	3	3	3	5	0	4	0
C8	Sales director	21	60	2	3	5	2	0	4	5
C8	Sales specialist	18	51	0	3	5	1	0	4	5
C8	Marketing specialist	12	34	1	1	5	1	0	4	0
C8	Regional assistant	16	46	3	4	2	0	0	3	4
C8	Product manager	19	54	3	2	5	1	0	4	4
C9	Sales director	15	43	0	4	5	1	0	4	1
C9	Sales specialist	12	34	0	2	5	1	0	4	0
C9	Marketing specialist	14	40	0	3	5	1	0	4	1
C9	Regional assistant	17	49	0	3	5	5	0	4	0
C9	Product manager	16	46	0	2	5	0	0	4	5
C10	Sales director	23	66	3	2	5	0	5	4	4
C10	Sales specialist	19	54	2	4	5	3	0	4	1
C10	Marketing specialist	13	37	2	3	2	1	0	4	1
C10	Regional assistant	15	43	2	4	5	0	0	4	0
C10	Product manager	23	66	3	1	4	5	0	4	6

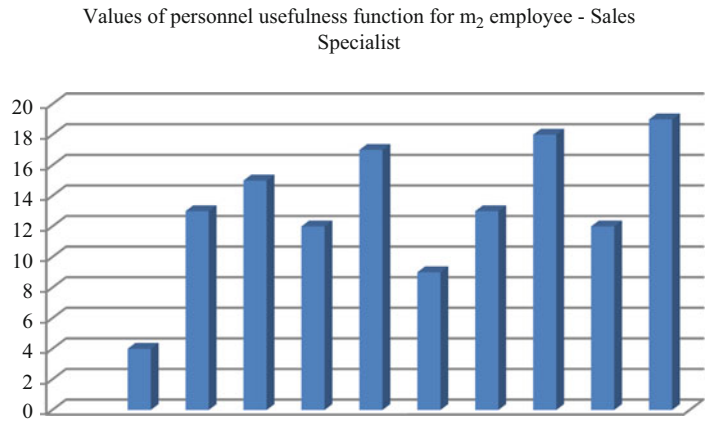

Fig. 4.3 Values of the personnel usefulness function for a sales specialist based on the research results

I will present the possibility of defining a decision-making model for assessing the value of strategic knowledge resources using the GMDH method. This enables values of the personnel usefulness function and those of the characteristics of innovation to be determined. The method involves the following assumptions (Farlow 1984): a precise description of the interdependence between output and input data (selected characteristics of innovation with the value of the personnel usefulness function in the company) and minimum modeling error. By implementing the GMDH algorithm, the best possible polynomial was obtained, which was characterized by the lowest-value criteria for regularity assigned to the pair object.

4.3.1.3 GMDH Algorithm

GMDH is a modeling algorithm based on processing empirical data. It was created by linking elements of the least-squares method and Gödel's theory, and it supplement a procedure for the synthesis of the hierarchical Iwachnienko polynominal (Goldberg 1989; Iwachnienko 1982; Kohonen 1984). GMDH was initially used for the precise prediction of the development of fish populations in rivers and oceans. The algorithm is based on a synthesis of the polynomial model. By integrating structural and parametric optimization concepts, Iwachnienko polynominal, which results from the GMDH procedure, is a model that ensures precise practical application (Iwachnienko 1982). The algorithm eliminates a deductive approach based on engineers' and experts' knowledge. Another important element is the use of polynomial evolution from an elementary structure to an optimized one by selecting various combinations of simple partial models. The features of GMDH include the following (Patalas and Krupa 2007):

- Precise description of relations between input and output data (selected indicators for assessing rationality and effectiveness of investment in

Table 4.3 Values of the characteristics of innovation based on the research results

Company/sale area	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
C1	1	2	1	1	1	1	5	5	2	1	1	1	5
C2	2	1	1	1	1	1	2	3	1	1	5	5	1
C3	1	1	1	1	1	1	3	5	1	1	1	1	5
C4	1	3	1	2	1	2	5	4	1	3	1	1	5
C5	1	1	1	1	1	1	2	5	1	1	1	1	3
C6	2	1	1	3	1	1	1	4	1	1	5	4	1
C7	2	2	1	5	1	1	2	5	1	1	1	1	2
C8	1	1	1	1	1	1	1	4	1	1	1	1	3
C9	1	4	1	5	1	2	3	5	1	2	1	1	5
C10	1	1	1	4	1	1	2	5	1	1	1	1	3

knowledge, namely investment in human resources and the effects of investment) in the long term,

- Minimizing modeling errors.

The main problem involves a response to the question "Does an assessment of a knowledge worker enhance the innovation level of a company?" (H1); or "Does the selection of a knowledge worker enhance the innovation level of a company?" (H2). I will attempt to find answers for the research hypotheses. In this regard, let us consider the following situation: the problem consisting of determining the value of the personnel usefulness function for the m-th knowledge worker in the sales area and the value of the characteristics of innovation in a company (Tables 4.2 and 4.3).

The decision model is constructed on the basis of the knowledge database. The application of empirical knowledge allows the GMDH algorithm to be used as a modeling tool. Finally, the decision model under examination binds the selected characteristics of innovation in a company with the values of the personnel usefulness function for each m-th knowledge worker. This restriction simplifies the decision-making process and gives it the characteristics of restriction propagation. This means that for some companies, the prediction value for a knowledge worker in terms of innovation level in the company can be made on the basis of previously defined indicators and the company's experience.

A decision-making model for assessing the effectiveness of knowledge worker selection in a company using the GMDH method is presented below.

4.3.2 Sknowinnov Model as a Decision-Making Model for Assessing the Value of Knowledge Workers

The design of this model starts with collecting information about the research subject. The data is obtained by observing the functioning of the subject. Construction of the model encompasses the following:

- Designing the structure of a model for a knowledge worker-oriented company (Sect. 3.2.2)

- Defining the values of strategic knowledge resources (of the knowledge workers) and the values of the qualifying criteria for an innovative company based on an empirical analysis of companies according with the reference model (Tables 4.1 and 4.3)
- Checking the quality of the forecast value of the strategic knowledge resources with the aid of the selected model

Finding knowledge workers who within a defined period of time will guarantee a desired innovation level (as expressed by chosen criteria) is part of the decision-making model. The solution may be presented in the form of the following tasks:

- The possibility for an objective choice (assessment) of an employee, assuming that the following concepts are known:
  - The standard operation areas of the company
  - The structures of business processes related to those areas
  - The values of the strategic knowledge resources
- The possibility of assessing the efficiency of the knowledge worker in terms of the level of innovation in a company

A four-element method for assessing the efficiency of the knowledge worker selection—the Sknowinnov method—has been established (Sect. 4.3.1). The four elements are as follows:

- A model of a company
- The value of the strategic knowledge resources
- The qualifying criteria for an innovative company
- An algorithm that enables the value of the strategic knowledge resources to be connected to the value of the qualifying criteria for an innovative company

The Sknowinnov method was created based on a study of the literature—Chaps. 2 and 3 in this area. It includes methods for assessing the value of IC and methods of employment planning and selection for an innovative company. The method combines available knowledge gained from the literature and the experience—research results of companies that have the potential for innovation. The method allows an assessment to be made regarding the future value of decisions made about selecting knowledge workers so as to increase innovation in a company.

So, a polynomial decision-making model was designed for employee selection by an innovative company. The model compiles all groups of the elements of the Sknowinnov method and consists of the following:

- A base of values for strategic knowledge resources and values for the qualifying criteria for an innovative company (Tables 4.1 and 4.2)
- A GMDH algorithm
- An analyzer of a logical model and an answer generator

A decision-making model for assessing the value of strategic knowledge resources (Sknowinnov model) is built using the GMDH algorithm (Fig. 4.4).

The basic purpose of the GMDH algorithm is to eliminate a deductive approach based on engineers and experts' knowledge. Another important element is the idea of polynomial evolution from an elementary structure to an optimized one by selecting various combinations of simple partial models. In the majority of cases, these are second-degree polynomials with two variables. According to this concept,

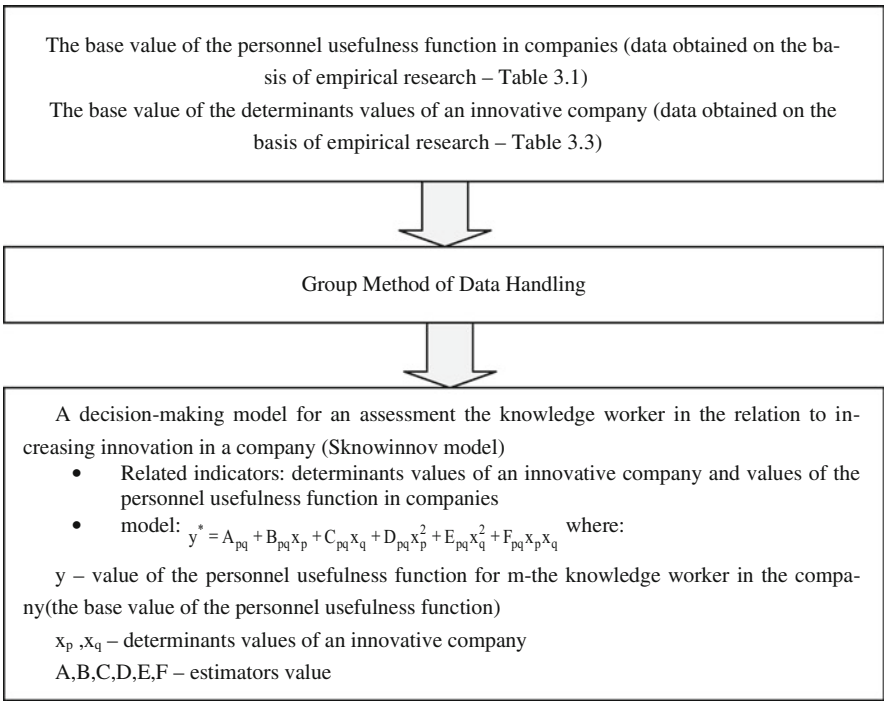

Fig. 4.4 Structure of the Sknowinnov model

at each iteration arguments supporting the elementary model are polynomial functions that consist of the previous iteration; the degree of the resulting polynomial doubles at each stage of the algorithm. Optimized values of fixed parameters are calculated using the least-squares method. Following publication of the details of the GMDH algorithm, many applications have confirmed its efficiency and broad utilization (Farlow 1984).

Examples of the practical application of the GMDH method based on retrospective data groups are as follows:

- In Britain in 1980–90, a 10-year forecast of inflationary changes was developed for the country using the GMDH method; (the GMDH model for inflation changes was identical with Britain's actual inflation in 1990–2000)
- In the United States in 1990–2000, the GMDH method was used to forecast the development of main economic growth factors
- In Ukraine in 1990–2000, the GMDH method was used to develop a 10-year normative forecast for macroeconomic processes
- The boiler house and steam station of a sugar plant in Lublin, Poland, uses GMDH for precise control of tracking elements. Research into the development and integration (including GMDH) and process-diagnosing techniques (particularly, the regulation valves) in the sugar plant in Lublin was carried out under the project called the Development and Application of Methods for Actuator

Diagnosis in Industrial Control Systems. This was funded by the fifth Framework Programme in 2000–2003, whose project coordinator was Ronald J. Patton, University of Hull, United Kingdom.

The multilevel GMDH algorithm allows the optimalized synthesis of a mathematical model for a given class of regression functions, and it can be used in evaluating criteria and in quality assessment. Both elements of the algorithm are defined arbitrarily by the developer. That is why the modeling must be preceded by an initial identification phase, which allows both defining the choice and the class of the solutions to be carried out. Taking into account the nature of the subject under examination and the tasks that support decision making at the strategic level (in terms of return on investment in knowledge), it can be assumed that the regression function takes the form of two variables. A particle selection of integers is carried out using the regularity criteria.

Developing an object model with the GMDH algorithm is carried out in stages. At every step, the population regression integer is generated. Because the regression function is a function of two variables, the polynomials are assigned to every possible pair of arguments. Their parameters are calculated using the least-squares method, i.e., using the sets of equation formulas. It can be concluded that the GMDH procedure is conditioned by a linear unit independence, which is a guarantee for the solution to be found (Farlow 1984).

Having generated the families of regressive polynomials, a selection is made of those that approximately fit in the interdependence under examination. As a result of calculation assumptions, it is assumed that the number of data (models) in a new population cannot be higher than in the previous one.

For each population of particle solutions, the lowest regularity criteria value is assigned (3). Steps 2 and 3 go through a loop until the value stops decreasing. This results in the optimal model being found—a polynomial of regression for which the criteria has reached the lowest value.

The Sknowinnov model allows a prediction of the characteristics of innovation that will result from hiring a knowledge worker. With this model, defined indicators of innovation in an enterprise with regard to the employment of knowledge workers can be determined. The company is thus in the position of being able to make an objective selection of knowledge workers.

The next chapter presents the decision-making model for an assessment of knowledge workers for increasing innovation in a company (Sknowinnov model). The author's IT tool for supporting decision making at the strategic level with regard to the assessment of knowledge in an innovative company (Appendix 2) will allow research to be conducted.

References

Acedo, F. J., Barroso, C., & Galan, J. L. (2006). The resource-based theory: Dissemination and main trends. *Strategic Management Journal, 27*, 621–636.

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organisational Behavior and Human Decision Processes, 82*(1), 150–169.

Armstrong, M. (2001). *Human resource management*. Kraków: Oficyna Ekonomiczna, Dom Wydawniczy ABC.

Barney, J. B. (1991). The firm resources and sustained competitive advantage. *Journal of Management, 17*, 99–129.

Barney, J. (1995). Looking inside for competitive advantage. *The Academy of Management Executive, 9*(4), 49–61.

Barney, J. B. (2001). Resource-based theories of competitive advantage: A 10-year retrospective on the resource-based view. *Journal of Management, 27*, 643–650.

Barney, J. B., & Zając, E. J. (1994). Competitive organizational behavior: Toward an organizationally-based theory of competitive advantage. *Strategic Management Journal, 15*, 5–9.

Barthelme, F., Ermine, J. L., & Rosenthal-Sabroux, C. (1998). An architecture for knowledge evolution in organisations. *European Journal of Operational Research, 109*(2), 414–427.

Basu, A. (1998). Perspectives on operations research in data and knowledge management. *European Journal of Operational Research, 111*(1), 1–14.

Becker, D. R. (2004). *Ressourcen-Fit bei M&A-Transaktionen: Konzeptionalisierung, Operationlisiernung und Erfolgswirkung auf Basis des Resource-based View*. Wiesbaden: DUV.

Berio, G., & Harzallah, M. (2005). Knowledge management for competence management. *Journal of Universal Knowledge Management, 0*(1), 21–38.

Boos, F., & Jarmai, H. (1994). Kernkompetenzen—gesucht und gefunden. *Harvard Business Manager, 16*, 19–26.

Boxall, P., & Purcell, J. (2000). Strategic human resource management: Where have we come from and where should we be going? *International Journal of Management Reviews, 2*, 183–203.

Carayannis, E. G. (1998). The strategic management of technological learning in project/program management: The role of extranets, intranets and intelligent agents in knowledge generation, diffusion, and leveraging. *Technovation, 18*(11), 697–703.

Chrisman, J. J., Chua, J. H., & Zahra, S. A. (2003). Creating wealth in family firms through managing resources: Comments and extensions. *Entrepreneurship Theory and Practice, 27*(4), 359–365.

Colbert, B. A. (2004). The complex resource-based view: Implication for theory and practice in strategic human resource management. *Academy of Management Review, 29*, 341–358.

Nosal, C. (2002). Time and psychological types—An attempt to reconstruct. In K. Maurin & A. Motycka (Eds.), *About thinking Junga*. Warszawa: Eneteia.

Draganidis, F., & Mentzas, G. (2006). Competency based management: A review of systems and approaches. *Information Management and Computer Security, 14*(1), 51–64.

Drew, S. (1999). Building knowledge management into strategy. Making sense of a new perspective. *Long Range Plan, 32*, 130–136.

Eriksen, B., & Mikkelsen, J. (1996). Competitive advantage and the concept of core competence. In N. J. Foss & C. Knudsen (Eds.), *Towards a competence theory of the firm* (pp. 54–74). New York/London: Routledge.

Farlow, S. J. (1984). *Self-organizing methods in modeling-GMDH type algorithms*. New York: Mersel Dekker.

Freiling, J. (2001). *Resource-based view und ökonomische theorie: grundlagen und positionierung des ressourcenansatzes*. Wiesbaden: Gabler.

Führing, M. (2006). *Risikomanagement und Personal: Management des Fluktuationsrisiko von Schlüsselpersonen aus ressourcenorientierter Perspektive*. Wiesbaden: Springer 11775.

Gajek, L., & Kałuszka, M. (2000). *Methods of statistical inference*. Warszawa: WNT.

Goldberg, D. E. (1989). *The genetic algorithms approach* (pp. 247–253). New York: Plenum Press.

Grant, R. M. (1997). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17*, 109–122.

Hamel, G., & Prahalad, C. (1994). *Competing for the future*. Boston: Harvard Business School Press.

Hays, S. W., & Kearney, R. C. (2001). Anticipated changes in human resources management: Views from the field. *Public Administration Review, 61*, 309–456.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource based view: Capability lifecycles. *Strategic Management Journal, 24*(10), 997–1010.

Hitt, M. A., Bierman, L., Shimizu, K., & Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal, 44*(1), 13–28.

Huselid, M. A., Jackson, S. E., & Schuler, R. S. (1997). Technical and strategic human resource management effectiveness as determinants of firms performance. *Academy of Management journal, 40*(1), 171.

Iwachnienko, A. G. (1982). *Induktiwnyj metod samoorganizacji modelej sloznych system po eksperymentalnym danym.* Kijów: Naukowa Dumka.

King, J. (2007). Developing evaluation capacity through process use. In J. B. Cousins (Ed.), *Process use in theory, research, and practice: New directions for evaluation* (p. 116). San Francisco: Jossey-Bass.

Kohonen, T. (1984). *Self-organization and associative memory*. Berlin: Springer.

Kosieradzka, A., Lis, S. (2000). Produktywność (Productivity). Warszawa.

Kostera, M. (2000). *Zarządzanie personelem (Personnel management)*. Warszawa: PWE.

Krämer, C., Ringling, S., & Yang, S. (2005). *Mastering HR management with SAP. The complete guide to SAP HR*. Bonn: Galileo Press.

Król, H., & Ludwiczyński, A. (2007). *Zarządzanie zasobami ludzkimi (Human resources management)*. Warszawa: PWN.

Lado, A. A., & Wilson, M. C. (1994). Human resource system and sustained competitive advantage: A competency-based perspective. *The Academy of Management Review, 19*(4), 699.

Lichtarski, J. (2000). Personnel function and personnel management. In T. Listwan (Ed.), *Personnel management*. Wrocław: Economical University.

Maier, R. (2002). *Knowledge management systems: Information and communication technologies for knowledge management*. Berlin: Springer.

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability view of rent creation. *Strategic Management Journal, 22*, 387–401.

McGrath, R., & MacMillan, I. (2000). *The entrepreneurial mindset*. Boston: Harvard Business School Press.

McKenna, E., & Beech, N. (1997). *Human resource management*. Warszawa: Gebethner&S-ka.

Nolte, H., Bergmann, R. (1998). Ein Grundmodell des ressourcenorientierten Ansatzes der Unternehmens-führung. In H. Nolte (Hrsg.): Aspekte ressourcenorientierter Unternehmensführung (S. 1–27). Hampp: Mün-chen – Mering.

Nordhaug, O. (1993). *Human capital in organizations*. Oslo: Scandinavian University Press.

Patalas, J., & Krupa, T. (2007). The prediction value of criteria of ERP system efficiency in small and medium size enterprises (SMES). In J. Jakubowski & B. Franczyk (Eds.), *Production engineering: Computer science driven production engineering*. University of Zielona Góra.

Patalas-Maliszewska, J. (2009). The concept of system supporting decision making enabling to asses and forecast of knowledge in SMEs—Research results. *Applied Computer Science, 5*(2), 27–41.

Patalas-Maliszewska, J. (2011). The personnel usefulness function—the method for planning and selection of personnel in SME. *Management, 15*(2), 132–143.

Patalas-Maliszewska, J., & Hochmeister, M. (2011). Modeling strategic-knowledge-resource management based on individual competencies in SMEs. *Contemporary Economics, 5*, 72–79.

Patalas-Maliszewska, J., & Werthner, H. (2010). Methodology of knowledge value assessment in an enterprise of SME sector. *Management and Production Engineering Review, 1*(1), 21–28.
Pawlak, Z. (2003). *Personnel business function—Processes and procedures for staff*. Warszawa: Poltext.
Penner-Hahn, J., & Shaver, J. M. (2005). Does international research and development increase patent output? An analysis of Japanese pharmaceutical firms. *Strategic Management Journal, 26*(2), 121–140.
Penrose, E. T. (1959). *The theory of the growth of the firm*. New York: Wiley.
Perry, E. L., Kulik, C. T., & Bourhis, A. C. (1996). Moderating effects of personal and contextual factors in age discrimination. *Journal of Applied Psychology, 81*, 628–647.
Pfeffer, J., & Salancik, G. (1978). *The external control of organizations: A resource-dependence perspective*. New York: Harper-Rowe.
Prezewowsky, M. (2007). Demografischer Wandel und Personalmanagement: Herausforderungen und Handlungsalternativen vor dem Hintergrund der Bevölkerungsentwicklung. Wiesbaden.
Priem, R. L., & Butler, J. E. (2001). Is the resource-based view a useful perspective for strategic management research? *Academy of Management Review, 26*, 41–56.
Purser, R. E., & Pasmore, W. A. (1992). *Organizing for learning. Research in organization or change and development* (pp. 37–114). London: JAI Press.
Ramos-Rodriguez, A. R., & Ruiz-Navarro, J. (2004). Changes in the intellectual structure of strategic management research: A bibliometric study of the strategic management journal, 1980–2000. *Strategic Management Journal, 25*(10), 981–1004.
Sekuła, Z. (2001). Planowanie personelu (Personnel planning). Kraków: Economical University.
Sirmon, D., & Hitt, M. A. (2003). Managing resources: Linking unique resources, management and wealth creation in family firms. *Entrepreneurship Theory and Practice, 27*, 339–358.
Smart, D. L., & Wolfe, R. A. (2000). Examining sustainable competitive advantage in intercollegiate athletics: A resource-based view. *Journal of Sport Management, 14*, 133–153.
Studer, R., Benjamins, V. R., & Fensel, D. (1998). Knowledge engineering: Principles and methods. *Data Knowledge Engineering, 25*(1–2), 161–197.
Szałkowski, A. (Ed.). (2002). Personel development. Kraków: Economical University.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*, 171–180.
Wright, P. M., Dunford, B. B., & Snell, S. A. (2001). Human resources and the resource based view of the firm. *Journal of Management, 18*, 207–229.